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Car Parking Detection System Using Deep Learning

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ABSTRACT—The car parking occupancy detection is one of the most important systems that are needed at various parking lots. The proposed system is Car Parking Detection using deep learning, the aim of this paper is to solve the issue of car parking which is done by taking images and videos from surveillance cameras and detecting the occupancy of the parking lot whether the parking space is Empty or Occupied. It uses Convolutional Neural Networks (CNN) Algorithm because it achieves most promising results when compared to the other traditional parking detections like Dijkstra and Ant colony Algorithms. This paper also uses the YOLOv3 object detection algorithm which is implemented by deep neural network architecture. By using above specified algorithms, the availability of the parking spaces in the parking lot is solved, so that the drivers do not waste much time in searching for the parking space and do not leave in frustration of not able to find the exact empty space. The car parking lot detection is tested on both images and videos and the results indicate that this method is most efficient in detecting a car space in parking lot.

I. INTRODUCTION

Currently, there are many detection methods for parking spaces. According to the categories of the selected sensors, they can be divided into visual and non-visual detection methods. The vision-based detection methods mainly use monocular cameras, binocular cameras, or RGB-Depth (RGB-D) cameras. By using cameras for image acquisition, based on the captured images, computer vision algorithms are applied to detect parking spaces. Those approaches provide real-time visual assistance and rich image information, but it could be greatly affected by environmental factors.

As the population grows there is an increase in the private vehicles which caused many issues to the people for find car parking space at the crowded areas such as shopping malls, restaurants and universities parking lots. This results in time waste for the drivers in search for the empty parking space which includes atmospheric pollution and frustration of the drivers.

The Smart Parking System consists of an on-site deployment of an IoT module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly. Parking sensors are used to detect the parking lot in particular area and gives to user by mobile application.

Our proposed system is to solve the issue of car parking which is done by taking videos from surveillance cameras and detecting the occupancy of the parking lot whether the parking space is Empty or Occupied. By using CNN technique, the main parking lot issue, that is availability of the parking spaces in the parking lot is solved, so that the drivers do not waste much time in searching for the parking space and do not leave in frustration of not able to find the exact Empty space.

II. LITERATURE SURVEY

In the paper tittled “Smart parking system using IOT” Asish joshi and ashritha discussed about the use of IoT at a parking lot will help vehicle users to know the availability of a parking location through smartphones. This IoT-based parking system is created by using controllers, sensors, servers and cloud. Controllers and sensors will be placed on the ceiling of each parking slots to detect the presence of a car. Server collect the results of the sensors and store them in Cloud. System test is conducted by installing three sensor circuits and server in a parking lot. The tests consist of measuring time that required for data transmission and the rate of success of data transmission from the parking lot to the Cloud. Basedon above tests, it is observed that the sensor circuit and Radio Frequency Identification are able

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to transmit the parking lot data without error.

In the paper titled "Automated parking space detection using CNN" Julien Nyambal, Richard Klein, Hongston shi , kuchapu kakiku presents an approach for a realtime parking space classification based on Convolutional Neural Networks (CNN) using Caffe and Nvidia DiGITS framework. The training process has been done using DiGITS and the output is a caffemodel used for predictions to detect vacant and occupied parking spots. The system checks a defined area whether a parking spot (bounding boxes defined at initialization of the system) is containing a car or not (occupied or vacant). Those bounding box coordinates are saved from a frame of the video of the parking lot in a JSON format, to be later used by the system for sequential prediction on each parking spot. The system has been trained using the LeNet network with the Nesterov Accelerated Gradient as solver and the AlexNet network with the Stochastic Gradient Descent as solver.

In the paper titled "Automated parking system based on imporved neural network" Yucheng guo, Hongston shi , kuchapu represents an intelligent parking system including service application layer, perception layer, data analysis layer, and management layer. (e network system adopts opm15 system, and the parking space recognition adopts improved convolution neural networks (CNNs) algorithm and image recognition technology. Firstly, the parking space is occupied and located, and the shortest path (Dynamic Programming, DP) is selected. In order to describe the path algorithm, the parking system model is established.

In the paper titled "A hybrid fog architevture improving the effiency in iot based parking system" depicts aboutthe abundant use of personal vehicles has raised the challenge of parking the vehicle in crowded places such as shopping malls. To help the driver with efficient and trouble free parking, a smart and innovative parking assistance system is required. In addition to discussing the basics of smart parking, Internet of Things (IoT), Cloud computing, and Fog computing, this chapter proposes an IoT-based smart parking system for shopping malls.

In the paper titled "Real time IP camera parking occupancy detection using deep learning Albertus, Hendri Hendra ,Hanry Bhawana suri, sheweta tanuja proposed the system of find the parking space in a crowded area is quite troublesome due to uncertainty whether the area has an empty parking space or not. If it does not have an empty space, thus it leads to over-stress before doing the main activity and more fuel used. Therefore, We show by only using a IP Camera could allow the parking occupancy detection in real time. The detection were performed by using several deep learning architecture: LeNet, AlexNet, mLeNet, and mAlexNet.

In the paper titled "IOT-based approach to monitor parking space in cities" Fatin Haque,Kumar yelamanti, Srinivas S ,Hanry ,sheweta tanuja represents Internet of Things is the next big thing, as almost everything developed now has an extensive use of data which is then used to get the daily statistics and usage of every individual. The work mainly consists of constructing a screen where the parking space will be shown, and a camera module will be set up, and PIR (Passive Infrared Sensor) will be at the entrance to detect the entrance of a car or any vehicle eligible to park at the lot.

In the paper titled "Evidence filter of semantic segmentation image from around view in automated parking system" proposed the system of an Around View Monitor (AVM) is widely used as one of the perception sensors for automated parking systems. By applying semantic segmentation based on a deep learning approach, the AVM can detect two essential elements for automated parking systems: slot marking and obstacles. However, the perception based on the deep learning approach in the AVM has certain limitations such as occlusion of the ego-vehicle region, distortion of 3D objects, and environmental noise.

In the paper titled "Car parking occupancy detection using yolov3" Arepalli rama venkat,naga sai , Kunji, Kumar yelamanti, sheweta tanuja proposed the car parking occupancy detection is one of the most important systems that are needed at various parking lots. For this thesis, CNNs have been used because they achieve most promising results than compared to the other traditional parking detections. This thesis presents a robust technique for the car parking occupancy detection by going through the most of the parking issues such as parking displacements, non-unified car sizes and inter object occlusion. This thesis presents a real-time Parking space detaction based on the Convolutional neural network.

In the paper titled "Smart parking ability for open parking lots" Vijaypaidi, Hasan Fleyeh,N amanti, sheweta tanuja represent sparking a vehicle in traffic dense environments is a common issue in many parts of the world which often leads to congestion and environmental pollution. Lack of guidance information to vacant parking spaces isone of the reasons for inefficient parking behaviour. Smart parking sensors and technologies

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facilitate guidance of drivers to free parking spaces thereby improving parking efficiency. Currently, no such sensorsor technologies are in use for the common open parking lot. This paper reviews the literature on the usage of smart parking sensors, technologies, applications and evaluate.

In the paper titled "Real time smart parking integration in distributed ITS" Hunag, S.wang, W.c. hiu , Hasan Fleyeh, Nyberg, Kunji, T. chen represents intelligent Transportation Systems (ITS) have evolved as a key research topic in recent years, revolutionizing the overall traffic and travel experience by providing a set of advanced services and applications. These data-driven services contribute to mitigate major problems arising from the ever growing need of transport in our daily lives. Despite the progress, there is still need for an enhanced and distributed solution that can exploit the data from the available systems and provide an appropriate and real-time reaction on transportation systems. Therefore, in this paper, we present a new architecture where the intelligence is distributed and the decisions are decentralized. The proposed architecture is scalable since the incremental addition of new peripheral subsystems is supported by the introduction of gateways which requires no reengineering of the communication infrastructure.

III. DESIGN METHODOLOGY

The model is designed with YOLO and MASK-RCNN algorithm. YOLO is used for object detection and MASK-RCNN is used for masking the parking lot images which are used by the skimage to determine whether it is empty or occupied. The below block digram deoicts the design methodology.

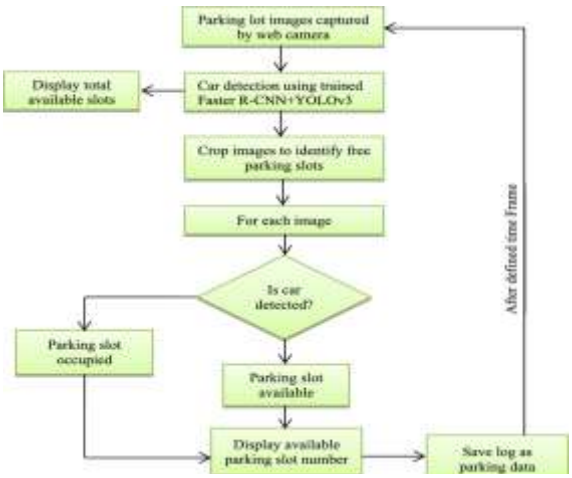

Figure 3.1:BlockdiagramofCar Parking detection system.

Figure3.1 describes the block diagram which shows the testing and training of the model and representing it in OpenCV .Initially it collects the data from and processing and goes on with validating the data .This data is used for traing the model and validating he model .After training of the data is done then it checks the accuracy of training model. On the basis of this model the Car parking lot is detected. Finally car parking lot is detected and indicated with red and green bounding functions.

IV. IMPLEMENTATION AND RESULTS

The dataset trained for this model is extracted from the kaggale website which contian empty and non empty slots of parking lot. Dataset contains 200 images of parking lot in which 80% of images where used for training and 20% of images are used for testing of model.The training of the model is done, but as YOLOv3 does not limit the number of iterations to be done, the system continuously trains the model. Usually 2000 iterations are sufficient for each class(object), but the iteration number should not be less than 4000 in total. But, for a better precision the training should be stopped for the iteration where the average loss no longer decreases or remains constant. So, when the training should be actually stopped depends upon the average loss function. The average loss function changes gradually from a higher value to the lower value and remains constant, then the training can be stopped. The weights file is generated and saved for every 1000 iterations and this can be changed in the configuration file for our desired number of iterations.

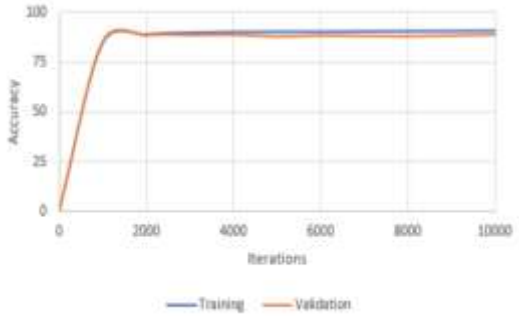

Figure 4.1: Graphical representation of training and validation and its accuracy for car parking occupancy detection.

Figure 4.1 describes that the graph is plotted by taking down the accuracies for every 1000 iterations. The first blue line indicated the training of the data and second one which is orange indicated the testing of the data.

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4.2.RESULTS

With the use of YOLO and MASK-RCNN algorithm the model successfully results with 94% accuracy .It shows the empty and occupied parking lots .

Figure 4.2 : Detection of the car parking lots.

Figure 4.2 represent the snapshots of the predicted output of the videos tested of the parking lot. At the top of the Figure 4.2 shows the number of available slots and the total number of slots in the parking lots. Then the driver can view the how many parking lots are available with the green mark indication and then occupied with the red mark indication.

S. no	Parkin-g lots	Process-ing time	Accu-racy
1	Lot1	4.5	94%
2	Lot2	4.28	87%
3	Lot3	4.8	82%
4	Lot4	4.9	83%

The accuracy of different parking lots with the processing time as shown above .The use of YOLO and MASK-RCNN alogorithms results the accurate output compared to the other traditional parking detections like Dijkstra and Ant colony Algorithms.

V. CONCLUSION

This paper will help in reducing the amount of time a driver has to spend around the parking lot just to find an available spot. Therfore it reduces the amount of traffic around the parking and also reducing the bad parking around the parking space. we have worked on Mask-RCNN to make a simple parking space detection system. We have also worked on YOLO object detection model. We have successfully detected the parking lots with YOLO object detection and M-RCNN which gives a accurate results with 94% effciency .

Future scope:

- To get better results, instead of using bounding boxes we can use the masks of detected cars for the calculation of IoU. Using masks in the calculations will result in more accurate IoU values.
- Red signal should be implemented when the person passes or walk through the parking lots to reduce accidents.
- For the better result the car parking detection should also use shortest distance path algorithm for detecting the near by parking lo t for the driver.

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